aceous than in *T. aurantiacum* and usually narrower and more acute. The fruit of *T. perfoliatum* is commonly more numerous and crowded than in *T. aurantiacum*, mostly 6–8 in each pair of axils, more globose and of a duller yellowish-orange color; at least, I have never seen it of as deep a flame color as that of *T. aurantiacum* sometimes becomes. Apparently also the species prefers a more sandy soil in lower, more level woods and thickets.

I have been unable to make out much difference in the distribution of the two species, although *T. perfoliatum* is perhaps rather more southern in its range. Specimens seen show a range from New York to Minnesota, Alabama, Kentucky and Kansas.

A MODIFIED FORM OF RESPIRATION APPARATUS

By H. M. Richards

There are many methods of all degrees of complication by which the amount of carbon dioxide evolved by plants may be measured. Many are simply out of the question for a laboratory which is not extensively stocked, requiring as they do a great array of glassware, many air-tight joints, siphons, aspirators or what not, while others are very crude. The writer has found the following simple and easily constructed piece of apparatus very useful for demonstrating in a fairly accurate way and on a somewhat large scale the respiration of plants. It is indeed a modification in form but not in principle of a method long used and often figured in many of the text-books. The apparatus referred to consists, as far as the glassware is concerned, of an exceedingly long-necked flask. Such flasks, however, must be specially blown and are consequently hard to obtain and also somewhat expensive. Instead of such a flask, an ordinary Bohemian one of 150 to 200 cc. capacity, with the neck of usual length, is selected. A test-tube, the closed and slightly tapering end of which was just a little too large to slip into the flask's neck, is next taken. By means of a little carborundum or emery-powder it is ground into the flask neck so as to get an air-tight closure, like that of the glass stopper in a bottle.

It may be noted here that carborundum is a very handy grinding material. It is harder than emery and cuts more quickly and may be obtained in any grade of powder from the manufacturers at the electrical works at Niagara Falls. The writer has prepared ground-glass plates of considerable size and has ground covers to dishes, joints in tubes, etc., with a minimum amount of trouble by means of this carborundum.

But to return to the respiration apparatus. The test-tube having been ground into the neck in a satisfactory manner, its end is next blown out, by heating and blowing while in a Bunsen flame. The hole thus produced may be easily enlarged to any size by moulding with a piece of cold metal.

The tube should now be graduated, which may be done by corking up the end of the tube and running in water from a burette, marking on a paper scale glued to the side any graduation—1 or 5 cc.—that is desired. For use, the flask is filled with seedlings, flowers, leaves, or whatever is to be investigated, and a plug of cotton, loosely poked in, to prevent their falling out when the flask is inverted. The extension of the neck is now put with its end (what as a test-tube was its mouth) over mercury. Some strong potash—say 50 per cent.—is run in at the top; the weight of the mercury will be enough to prevent as much, at least, as 5 cc. from running out. The ground joint of the test-tube is now painted liberally with vaseline, or better vaseline and wax, and the correspondingly ground flask joined to it. The whole apparatus is supported by a clamp on a retort-stand over the dish of mercury.

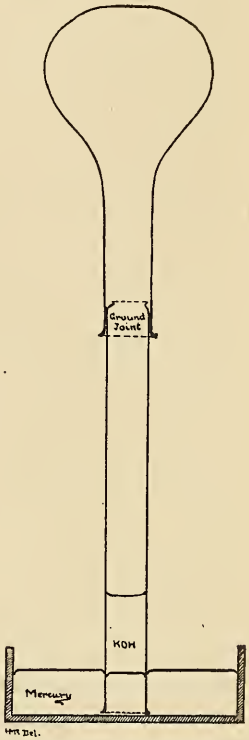

Diagram of Section. The apparatus is supported by a clamp to a retort-stand. The flask is the receiver for flowers, seeds, etc. The tube may be graduated or the results may be read simply by comparison.

You now have such a flask with an elongated neck as is figured in the text-books, but with the advantage that, the neck being in two pieces, the potash can be introduced in the manner described with the greatest ease. As the carbon dioxide is evolved, it, of course, sinks and is absorbed by the alkali, the diminution in volume of the air within the flask being shown by the corresponding rise of the mercury in the neck. The tube being graduated, this absorption can be readily observed and noted.

The apparatus is so simple and so quickly and cheaply put together, that several may be set up side by side for comparison of the respiration of different plant organs under different conditions. There are certain errors to be guarded against. The rise of the column within the neck should be read from the mercury surface and not from that of the potash above it, since the latter absorbs water as well as carbon dioxide. Great change of temperature should also be guarded against, since it alters the volume of gas within the flask, and to this the apparatus is very sensitive. If the volume of the flask and neck, less the contents, be taken, the proper correction for temperature variation may be applied. There is also an error introduced by the variation of vapor tension due to the possible change of the moisture in the enclosed air, but this is not considerable. Such a union by a ground joint is vastly to be preferred to cutting off the flaring mouth of the flask and uniting it to a tube by a rubber joint. The manipulation of a rubber tube of such size and under such conditions is annoying in the extreme. The ground joint prepared as above and well sealed with vaseline has proved itself to be entirely air-tight.

THRIVING UNDER DIFFICULTIES

By David Griffiths

A sewer pipe three feet underground is not only uninviting but rather an unusual object of botanical study. Yet associated with such a structure on the campus of the University of Arizona, the workmen uncovered one of the most interesting struggles for ex-